# **CHAPTER I: GENERAL INTRODUCTION**

**1. Background of the Study**

Higher education institutions require efficient communication among students and both academic personnel and administrative staff to maintain operational excellence on campus(Balzer, 2020). At institutions like INES-Ruhengeri provides various organizational services that sustain educational activities alongside student welfare alongside maintenance requires and administrative operations. Such essential operational tasks face various problems which students and faculty members and staff can report as complaints. The most often reported problems involve delays in service provision in combination with insufficient infrastructure and staff unresponsiveness together with perceived administrative ineffectiveness.

Education institutions use various manual and semi-automated methods including physical complaint desks and email submissions and suggestion boxes to receive and handle complaint. Traditional complaint management methods regularly encounter various problems because they generate slow replies and are nontransparent while struggling to monitor complaint progress and fail to use data-based approaches. The excessive complaints and their complexity drive administrative units to exhaustion that causes dissatisfied stakeholders while simultaneously eroding institutional reputation(Demchenko, 2021).

An unsmart system that does not allow complaint tracking and classification alongside complaint prioritization and resolution management creates new and more critical problems for these situations. Recent developments in Artificial Intelligence mark the start of an period which enables the resolution of those inefficiencies. Artificial Intelligence represents a system where machines duplicate human intellectual capabilities especially through computer programs. Learning represents the acquisition process of both information along with conceptual rules for its utilization followed by reasoning activities that use rules to derive estimated or absolute conclusions and self-correction steps. AI technology enables complaint management systems to reach higher levels of automation as well as improve accuracy together with responsiveness and customization in the user complaint resolution process(Kormpho et al., 2018).

The AI subfield NLP allows systems to decode human language so they can process natural language complaints to detect what problems customers face and how seriously they require attention plus their emotional response. Machine learning algorithms execute two functions - first they identify complaint categories while secondly**,** they forecast which issues persist and create recommendation plans using historical data patterns. for example AI-powered chatbots are able to handle first contact customer service by providing live question answers followed by human personnel support for difficult problems(Naroliya, 2024).

As researcher seek to create an AI-based tracking and response system which will function specifically for INES-Ruhengeri campus complaints. The system will unite three elements: NLP for complaint interpretation and machine learning for quality classification and priority setting and smart report generation tools for administrative choices. Such a system implementation enables the institution to achieve higher operational efficiency along with better transparency and satisfied beneficiaries. The goal of the project develops an adaptable framework for complaint management that academic institutions can use to address their similar challenges in complaint processing(Alex, 2023).

**2. Problem Statement**

In a typical universities and higher education institution setting such as INES-Ruhengeri, the handling of campus-related complaints whether academic, administrative, or infrastructural follows a conventional process. Students and staff often lodge complaints through physical forms, suggestion boxes, or informal communication with administrative personnel. These submissions are then manually reviewed, categorized, and forwarded to the relevant departments for further action. While this traditional approach has been functional, it is inherently limited by delays, inefficiencies, and a lack of systematic tracking(Roitblat et al., 2010).

The rising amount and variety of complaints make traditional manual processes unable to deliver prompt responses in addition to maintaining correct classification together with clear resolution paths. The institution's accountability along with its responsiveness to issues diminishes when complaints are either delayed or mishandled or neglected. A lack of centralized data system prevents tracking recurring problems in operations which denies institutions the ability to take preventative measures for strategic advancements. INES-Ruhengeri currently lacks a standardized complaint management system which prompts students to contact their relevant academic units independently thus creating workload problems within departments that can subsequently damage normal operational procedures.

The transformative capability of artificial intelligence (AI) enables solutions to address current problems in the specified systems. The complaint management process as a whole can be optimized using Natural Language Processing (NLP) together with Machine Learning (ML) and automated capabilities. The complaint interpretation function of NLP operates automatically for classification purposes while ML algorithms analyze historical data to determine criticality levels then select proper replies and AI-managed dashboards deliver time-sensitive analyses to leaders.

The main focus of this research involves creating and developing an AI-informed campus complaint tracking and response framework while conducting the case study with INES-Ruhengeri. The proposed system uses AI capabilities to automate complete complaint management events starting from complaint intake through categorization to prioritization and complaint monitoring of student staff and faculty reports(Alex, 2023). The system employs Natural Language Processing techniques and machine learning methods to shorten response times and promote both redundant-free operation and complaint allocation according to priority and subject matter.

**3. Research Questions**

In academic institutions such as INES-Ruhengeri, effective complaint management is critical for maintaining operational efficiency and stakeholder satisfaction. However, traditional approaches to handling complaints often involve manual procedures that are time-consuming, inconsistent, and lack transparency. With the growing complexity and volume of complaints, there is a need to explore how Artificial Intelligence can be integrated into the institutional complaint management system to enhance responsiveness, accuracy, and decision-making.

1. What types of complaints are most commonly raised by students, staff, and faculty within the institution?
2. How effective are the existing methods in tracking, prioritizing, and resolving these complaints?
3. How can Artificial Intelligence, particularly Natural Language Processing and Machine Learning, be applied to improve complaint management processes?

**4. Objectives of the Study**

The primary objective of this study is to develop an AI-powered framework for tracking and responding to campus complaints, using INES-Ruhengeri as a case study. The framework aims to enhance efficiency, accuracy, and transparency in complaint management. Specifically, the study seeks to:

1. To provide a smart, responsive platform for lodging and resolving complaints.
2. To enable real-time tracking of complaint statuses by students and staff.
3. To use AI to categorize, prioritize, and route complaints to the right departments.
4. To enhance transparency, accountability, and student satisfaction.
5. To analyze trends and generate reports for decision-makers based on complaint data.

**5. Choice of the Study**

Higher education institutions like INES-Ruhengeri are dynamic environments where various administrative, academic, and student-related operations occur daily. With this complexity comes an inevitable rise in complaints related to services, infrastructure, communication gaps, and academic processes. Traditionally, such complaints are managed through manual systems that often lack efficiency, traceability, and timely resolution, leading to dissatisfaction among stakeholders(Shuja et al., 2023).

The choice of this study is motivated by the growing need to modernize complaint management systems through intelligent, automated solutions. By focusing on an AI-powered framework, this research seeks to address the limitations of current methods and leverage technologies such as Natural Language Processing and Machine Learning to streamline complaint intake, classification, prioritization, and resolution tracking. INES-Ruhengeri serves as an ideal case study due to its representative structure and the potential to benefit from an innovative, data-driven approach to campus service improvement.

**6. Significance of the Study**

An efficient management system for complaints in academic institutions helps to ensure open accountability as well as enhances transparency and continuous development. INES-Ruhengeri manages complaints by using manual processes which results in decreased efficiency because it produces delays and wrong classifications without adequate feedback options. Institutional responsiveness suffers from low trust which adversely affects how well services are delivered to students(Ghosh et al., 2001).

The research makes an important contribution through the development of an artificial intelligence framework which enhances automation of complaint management processes. The framework utilizes Natural Language Processing and Machine Learning from Artificial Intelligence to process complaints through automatic classification and prioritization before directing them for prompt adequate responses. Through its implementation the system handles administrative workloads efficiently as it supports data-driven decision processes and creates better user satisfaction(Singh & Jasial, 2021). Research findings will support digital transformation in higher education service management and create an example model for institutions dealing with similar service issues(Singh & Jasial, 2021).

**7. Delimitation of the Study**

This investigation focuses on creating an AI-based system that monitors and addresses all complaints submitted to INES-Ruhengeri regarding campus services. The system concentrates on handling complaints submitted from students and academic staff and administrative personnel who address academic services alongside administrative procedures and campus infrastructures and welfare needs.

The research study addresses only complaints that come from INES-Ruhengeri's internal stakeholders regarding campus operational issues but excludes external complaints. The system does not include cases which need extended formal investigations nor can it address legal nor disciplinary matters. During operation the main Artificial Intelligence elements which incorporate Natural Language Processing and Machine Learning technology operate through textual data inputs but fail to handle voice and image-based complaints(Agrawal & Jain, 2020).

The research project focuses on designing and testing the proposed system at INES-Ruhengeri without seeking deployment across the whole institution during this research period. The research results together with framework components create potential specifications which institutions can use to scale their operations in the future.

**8. Research Methodology**

The implementation of the AI-Powered Campus Complaint Tracking and Response Framework contains four phases using a mixed-methods research approach for systematic development. The research method blends quantitative measurements with qualitative data analysis to achieve better complaint handling through AI innovation at INES-Ruhengeri.

The first stage starts with literature research about complaint systems within campuses together with AI applications for service automation. The analysis will gain important information about existing complaints processing problems and user demands through face-to-face discussions and survey responses from INES-Ruhengeri's students and staff and administrative teams. The gathered information will guide both the functional characteristics and non-functional specifications of the proposed system development followed by complete project planning(Zhou, 2004).

During Phase 2 the framework will go through development and testing alongside system design through an agile methodology which enables incremental advancement and direct feedback incorporation. A complaint submission interface together with NLP-enabled AI for classification form the core system components which also feature an ML section for response prediction and priority assignment. The application development will occur through Microsoft Visual Studio: Visual Studio with. Testing both the functional abilities and usability of the program will happen after each development sprint ends(Guckenheimer & Loje, 2012).

The last phase of the project encompasses the assessment of framework effectiveness through evaluation as well as reporting stages. The system evaluation will consist of evaluating four performance indicators which include system accuracy alongside response efficiency and complaint resolution rate and user satisfaction metrics. All data collection processes will utilize system logs as well as gather user feedback alongside standardized evaluation forms. The report will summarize system performance results and research conclusions together with future recommendation proposals from this study.

**9. Organization of the Study**

This dissertation is structured into five chapters, each serving a specific purpose in addressing the development and implementation of an AI-Powered Campus Complaint Tracking and Response Framework, with INES-Ruhengeri as a case study.

Chapter One: Introduction This chapter provides a comprehensive background of the study, presents the problem statement, outlines the research objectives and questions, and explains the significance, scope, and delimitation of the study. It also introduces the rationale behind using AI to address inefficiencies in campus complaint management systems. Chapter Two: Literature Review This chapter critically reviews existing literature on complaint management in academic institutions, traditional and automated tracking systems, and the application of Artificial Intelligence in service delivery. It identifies research gaps and positions the proposed framework within the broader context of current technological advancements. Chapter Three: Research Methodology This chapter outlines the research design and methodological approach adopted in the study. It details the data collection techniques, system development process, tools and technologies used, and the procedures for testing and evaluation. Ethical considerations and validity strategies are also discussed. Chapter Four: System Design and Implementation  
This chapter presents the practical aspect of the study. It describes the design architecture of the proposed AI framework, including system functionalities, user interfaces, and the integration of Natural Language Processing (NLP) and Machine Learning (ML) models. It also explains the testing processes and user feedback integration. Chapter Five: Results, Discussion, and Conclusion The final chapter discusses the findings from system evaluation and user testing. It interprets the results in relation to the research questions and objectives, highlights the implications of the study, and presents conclusions and recommendations for future research and institutional adoption.

# **CHAPTER TWO: LITERATURE REVIEW**

**2.1 Introduction**

Complaint management is a critical function in academic institutions, as it reflects the responsiveness, accountability, and service quality of the organization. Traditionally, institutions like INES-Ruhengeri rely on manual or semi-digital processes for complaint intake, categorization, and resolution. These conventional approaches often suffer from inefficiencies such as delayed responses, lack of transparency, inconsistent tracking, and inadequate feedback mechanisms. As a result, the effectiveness of addressing grievances from students, faculty, and staff is significantly compromised, leading to dissatisfaction and a weakened institutional reputation.

The growing demand for more responsive and intelligent systems has led researchers and practitioners to explore innovative technologies, including Artificial Intelligence (AI), for automating and optimizing complaint handling workflows. AI technologies such as Natural Language Processing (NLP) and Machine Learning (ML) have demonstrated potential in automating the classification, prioritization, and routing of complaints based on predefined patterns and contextual understanding.

**2.2 Related Works**

In recent years, several studies and technological solutions have addressed the challenges of complaint management within academic institutions. Understanding these related works is essential to identifying best practices, existing limitations, and the potential role of artificial intelligence in improving institutional responsiveness.

**2.2.1 University of Nairobi Student Grievance Portal**

The University of Nairobi implemented a web-based grievance portal designed to allow students to submit complaints regarding academic, administrative, and welfare issues. This platform facilitated digital submission, tracking, and status updates. However, it lacked intelligent automation, relying heavily on human administrators for complaint sorting and response . As a result, issues such as delayed feedback and misclassified complaints remained prevalent(Uwah & Etim, 2024).

**2.2.2 Georgia State University AI Chatbot (Pounce)**

Georgia State University deployed an AI-powered chatbot named “Pounce” to answer student inquiries and reduce administrative workload. Using Natural Language Processing (NLP), the chatbot handled thousands of routine queries and helped reduce summer melt by increasing student engagement. Though not a complaint-specific system, this application showcased the power of AI in automating student support and improving institutional efficiency(Hu et al., 2024).

**2.3 Definition of Key Terms**

This section defines essential technical concepts that contribute to the development and deployment of the AI-powered complaint tracking and response framework. Understanding these terms is critical to grasping the structure, functionalities, and technologies applied in the proposed system.

**2.3.1 Web Platform Development**

Web platform development refers to the process of designing and building applications that are accessible through web browsers. In this study, a web platform will be created to allow students and staff at INES-Ruhengeri to submit complaints, track status updates, and receive feedback. It serves as the user interface for the system’s operations and AI integrations(Taivalsaari et al., 2008).

**2.3.2 Cross-Platform**

Cross-platform development involves creating software that can run across multiple operating systems using a single codebase. The proposed framework will be developed as a cross-platform solution to ensure accessibility on both desktop and mobile devices, enhancing user engagement and flexibility.

**2.3.3 Front-End Development**

Front-end development focuses on the client-facing aspects of the application, including design, responsiveness, and user experience(Ho, 2023). In this study, front-end technologies will be employed to build an intuitive and interactive interface through which users can easily lodge and monitor complaints.

**2.3.4 Back-End Development**

Back-end development entails the server-side logic that powers the application’s core functionalities(Uunonen, 2023). In this research, it will support operations such as data processing, complaint categorization, AI-based prioritization, and communication between the front-end and the database.

**2.3.5 Database**

A database is a structured repository for storing, retrieving, and managing data. The complaint framework will use a database to store user profiles, complaint details, classification results, and response logs, ensuring data consistency and accessibility for analysis(Virk, 2024).

**2.3.6 Django Framework**

Django is a robust, open-source Python web framework that promotes rapid development and clean design. It will serve as the backbone of the application’s backend architecture, enabling scalable database operations, secure user authentication, RESTful API integration, and deployment of AI models within a modular structure(Forcier et al., 2008).

**2.3.7 Visual Studio Code (Development Environment)**

Visual Studio Code (VS Code) is a lightweight, powerful code editor used for software development. In this project, it will be the primary IDE for writing, testing, and debugging both front-end and back-end components, especially for Python, Django, and front-end technologies.

# **CHAPTER III: RESEARCH METHODOLOGY**

3 introduction

This chapter delineates the methodological framework employed to investigate the development and implementation of an AI-powered campus system, with a focus on transforming complaint management processes within a higher education setting. The methodology is structured to align with the research objectives of designing, developing, and evaluating an artificial intelligence solution that enhances institutional responsiveness, operational efficiency, and stakeholder satisfaction.

By adopting a case study approach at INES-Ruhengeri, the research explores the contextual challenges and opportunities associated with integrating AI technologies into existing administrative workflows. A mixed-methods research design, combining quantitative performance metrics with qualitative user insights, is employed to capture a comprehensive understanding of the system's impact. Data collection encompasses surveys, interviews, observations, and analysis of institutional records, ensuring both breadth and depth of evidence.

### 3.1 Choice of Study

This research adopts a **case study approach**, focusing on INES-Ruhengeri, a higher education institution situated in Rwanda. The selection of INES-Ruhengeri is strategically informed by several factors that align with the objectives of this study:

**Representativeness**: INES-Ruhengeri exemplifies administrative and operational challenges commonly encountered in higher education institutions, particularly concerning complaint resolution processes. These challenges include prolonged response times, lack of systematic tracking mechanisms, and limited feedback loops, which are indicative of broader systemic issues within similar academic settings. Thus, insights derived from this case study are anticipated to have broader applicability and relevance to comparable institutions.

**Feasibility**: The researcher's established access to a diverse range of institutional stakeholders—including students, academic staff, and administrative personnel—facilitates comprehensive data collection and iterative system prototyping. This accessibility ensures that the research can be conducted efficiently and that the developed AI-powered complaint management system can be tailored to the specific needs and contexts of the institution.

**Innovation Need**: Currently, INES-Ruhengeri lacks an AI-driven mechanism for complaint resolution, relying instead on manual processes that are susceptible to inefficiencies. This absence presents a unique opportunity to introduce and evaluate an AI-enhanced solution aimed at streamlining complaint management, thereby potentially transforming the institution's approach to handling grievances.

By focusing on INES-Ruhengeri, this study aims to explore the practical implementation of AI technologies in a real-world educational context, providing valuable insights into the potential benefits and challenges associated with such innovations in complaint management systems.

## 3.2 Research Design

A **mixed-methods design** underpins the research methodology, incorporating both quantitative and qualitative approaches to provide a holistic evaluation of the proposed system:

* **Quantitative Data**: Captured from system performance metrics such as complaint response time and resolution rate.
* **Qualitative Data**: Collected through surveys and interviews to evaluate user satisfaction, usability, and acceptance of the new system.

The research is applied in nature and follows a three-phased structure:

1. **Exploratory Phase**: Involves literature review, stakeholder consultations, and identification of system requirements.
2. **Development Phase**: Follows Agile development principles to design and prototype the AI-powered complaint management system.
3. **Evaluation Phase**: Tests the framework's performance against predefined Key Performance Indicators (KPIs) and gathers user feedback for iterative improvements.

This research design ensures both technical and user-centric perspectives are addressed.

## 3.3 Population and Sampling

### Target Population

The primary target population consists of students, academic staff, and administrative personnel at INES-Ruhengeri, estimated at approximately 300 individuals. Secondary participants include IT personnel and department heads responsible for handling complaints.

### Sampling Technique

A **stratified random sampling** method is employed to ensure representation across key institutional segments, including:

* Various academic departments.
* Administrative units.
* Student cohorts at undergraduate and postgraduate levels.

### Sample Size

* **Survey Participants**: A minimum of 300 respondents, aligning with a 95% confidence level and 5% margin of error.
* **Interviewees**: Between 15 and 20 key informants, with saturation guiding the final count.

This stratified approach provides a balanced and statistically valid understanding of stakeholder needs and perceptions.

## 3.4 Data Collection Techniques and Tools

### Primary Data

1. **Surveys**
   * **Tool**: Structured questionnaires incorporating both Likert-scale and open-ended questions.
   * **Objective**: Identify existing challenges in the manual complaint process and user expectations for the new system.
   * **Platform**: Administered via Google Forms or Kobo Toolbox for broader accessibility.
2. **Interviews**
   * **Type**: Semi-structured interviews with IT personnel, administrators, and academic staff.
   * **Purpose**: Gain insights into the technical feasibility and organizational readiness for AI adoption.
3. **System Observations**
   * Analysis of complaint handling logs before and after system implementation to assess performance improvements.

### Secondary Data

* **Literature Review**: Sourced from academic journals, conference proceedings, and technical reports relevant to AI in complaint management.
* **Institutional Records**: Historical complaint data, used to train machine learning models and evaluate existing patterns.

## 3.5 Data Processing and Analysis

### Quantitative Analysis

* **Descriptive Statistics**: Used to summarize central tendencies in response time, number of resolved complaints, and system accuracy.
* **Inferential Statistics**: Regression models employed to identify key variables influencing resolution efficiency.
* **Tools**: Python libraries (Pandas, Scikit-learn) and SPSS for statistical modeling.

### Qualitative Analysis

* **Thematic Analysis**: Conducted using NVivo software to extract recurring themes and concerns from interview transcripts.
* **Sentiment Analysis**: Natural Language Processing (NLP) techniques applied to user feedback to assess emotional responses and satisfaction levels.

### Triangulation

To ensure credibility and dependability of findings, triangulation is applied by comparing results from surveys, interviews, and system logs.

## 3.6 Limitations

1. **Technical Constraints**
   * Variability in NLP model performance for multilingual complaint inputs.
   * Limited computational resources may restrict large-scale pilot testing.
2. **Human Factors**
   * Possible resistance from staff unfamiliar with AI tools.
   * Social desirability bias in survey responses.
3. **Generalizability**
   * While the findings are contextually grounded, application to institutions with differing infrastructures may require adaptation.

**Mitigation Strategies**:

* Conduct iterative pilot testing and incorporate continuous feedback.
* Fine-tune NLP models with multilingual datasets.

## 3.7 Ethical Considerations

1. **Informed Consent**
   * All participants will receive clear information regarding the research objectives and voluntarily agree to participate.
2. **Anonymity and Confidentiality**
   * Personal identifiers will be removed from datasets. Data will be stored securely and accessible only to the research team.
3. **Data Security**
   * Encryption protocols and secure databases will be employed to ensure compliance with GDPR and Rwanda’s data protection laws.
4. **Bias Mitigation**
   * Regular algorithmic audits will be performed to detect and rectify any bias in complaint categorization and prioritization.

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